

**ARMY AIR DEFENSE FOR FORWARD AREAS:  
STRATEGIES AND COSTS**

The Congress of the United States  
Congresssional Budget Office

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#### **NOTES**

Unless otherwise indicated, all years in this report are fiscal years.

All dollar amounts are in 1987 dollars unless otherwise noted.

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## PREFACE

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The Army's forward air defense program was thrown into disarray when the Secretary of Defense cancelled the plagued DIVAD anti-aircraft gun in August 1985. Since then, the Army has been in the process of defining a new air defense program to present to the Congress. The program that the Army ultimately chooses will have significant implications for funding requirements and conventional force survivability not only during the next five years, but for years thereafter. Air defense programs will compete for funds with other high priority programs at a time when growth in defense spending is being slowed significantly. This analysis by the Congressional Budget Office (CBO) presents alternatives for improving the Army's air defense capability, particularly against attack helicopters, and compares the costs and capabilities of the various options. The study was requested by the House Committee on Armed Services. In keeping with CBO's mandate to provide objective analysis, the study offers no recommendations.

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## SUMMARY

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The Army's plan to modernize its air defense was set back significantly when tests demonstrated that the DIVAD gun could not adequately perform its air defense mission, and Defense Secretary Caspar W. Weinberger subsequently cancelled the program in August 1985. The 40mm DIVAD anti-aircraft gun was intended to replace the 1960s vintage Vulcan 20mm anti-aircraft gun, which currently provides air defense for the Army's tanks and fighting vehicles--the "forward maneuver elements" of the Army's "heavy" divisions. Vulcan, however, offers little capability against enemy aircraft, especially helicopters that can stand off at long ranges while attacking tanks and other armored vehicles. The loss of time that was invested in the DIVAD program has created a sense of urgency within the Army for devising a new air defense program to provide protection for its forward maneuver elements. As a result, the Army is considering a number of approaches to improve its forward air defense that cover a wide range of capabilities and costs.

The Army and the Department of Defense are currently attempting to decide on a particular approach as they formulate a comprehensive air defense plan to be presented to the Congress next year. The Congress might wish to influence various aspects of the overall air defense plan as it reviews the fiscal year 1987 budget request. Although the funds requested for air defense in the 1987 budget provide mainly for development of a variety of systems and do not reflect any specific configuration, the Congress will eventually have the opportunity to review the Army's more detailed plan for its air defense, probably some time next year.

## THE AIR DEFENSE MISSION AND U.S. CAPABILITIES

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Groups of armored vehicles, such as tanks and armored personnel carriers, form the front line of defense against any potential Warsaw Pact invasion of Central Europe. Should the Warsaw Pact invade, these groups of fighting vehicles, known as the maneuver elements, would come under fire from enemy aircraft as well as enemy ground forces. The airborne threat would come both from fighter bombers strafing and delivering bombs and from attack helicopters launching long-range antitank missiles. Because modern helicopters equipped for the antiarmor mission can attack targets from

long range and low altitudes--from five to six kilometers (km) away and as low as 20 meters--they have a definite tactical advantage over fighter bombers when performing antiarmor missions. For this reason, the emphasis for providing air defense for front line armored forces has shifted over the last 20 years from countering fighter bombers to defeating standoff helicopters, although the need to counter fixed-wing aircraft still exists.

The mission of overcoming enemy helicopters attacking U.S. armored vehicles would fall mainly on ground-based air defense systems. Although the United States has traditionally relied on both ground-based air defense systems and interceptor aircraft to protect U.S. troops on the battlefield, high-speed fighter aircraft are not very well-suited for the antihelicopter role. Attack helicopters fly very close to the ground and hover almost motionless when seeking or firing upon targets. These tactics make them difficult to locate from the higher altitudes used by fighter aircraft and inappropriate targets for typical air-to-air missiles carried on fighter aircraft. Consequently, fighter aircraft are not likely to contribute significantly to the defense against standoff helicopters.

#### Requirements for a Successful Air Defense

Sufficient range and numbers are the primary requirements for a ground-based air defense capable of defeating modern attack helicopters armed with long-range antitank missiles. Individual air defense weapons, usually located up to a kilometer behind the most forward troops to ensure their own survivability, must be able to destroy enemy helicopters attacking armored assets from ranges of five to six km. Thus, these air defense systems should have a maximum range of at least seven to eight kilometers.

Large numbers of air defense weapons would be needed to protect armored assets from the expected heavy air attack by Warsaw Pact forces in the European theater. Individual air defense systems have a low probability of seeing helicopters at the long ranges and low altitudes from which they could attack. This is especially true in Central Europe where hilly and wooded terrain offers ample cover for enemy helicopters. Thus, many dispersed air defense systems--up to 80 per division--might be needed to provide a reasonable assurance that each attacking helicopter could be engaged. In order to field air defenses in such large numbers, individual systems would need to be relatively inexpensive.

Other characteristics would also be needed in an effective air defense system designed for use in Europe. The air defense weapon should be able to

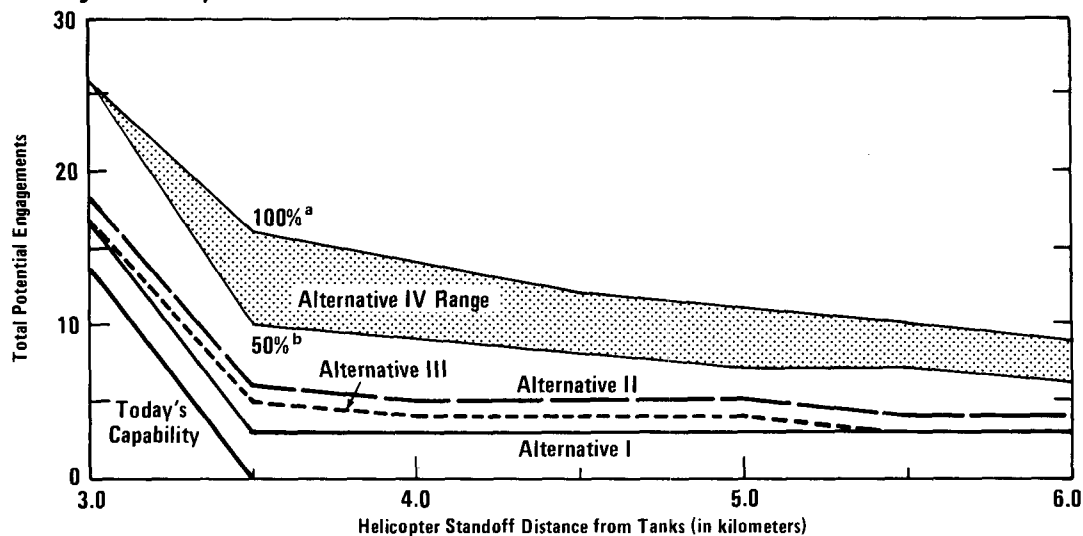
operate at night. It must be able to react quickly to helicopters that pop up to deliver their weapons. Finally, it must be as mobile and as well-protected as the armored systems it is defending.

### TODAY'S CAPABILITIES

Today's U.S. air defenses do not have sufficient range, nor are they deployed in sufficiently large numbers, to provide a credible defense against enemy attack helicopters. One measurement of the Army's air defense capability against standoff helicopters is the total number of systems within a battalion-sized task force of 40 to 60 armored vehicles that could potentially engage an enemy helicopter attacking those armored vehicles. This measure of "potential engagements" takes into account the relative positioning of the various armored and air defense systems within the task force, their effective range, and their likelihood of being able to see an attacking helicopter in hilly European terrain. The number of potential engagements is, of course, a simplified measure that ignores many of the complexities of battle, but it does provide a rough guide for comparing the capability of forces containing differing combinations of systems (see Summary Figure).

Summary Figure.

Comparison of Potential Engagements of Hovering Helicopters with Today's Weapons and Those Included in Alternatives I, II, III, and IV



SOURCE: Congressional Budget Office.

NOTE: Assumes enemy helicopters hover at an altitude of 20 meters.

<sup>a</sup> All weapons engage helicopters.

<sup>b</sup> One-half of tanks and fighting vehicles engage helicopters.

None of today's weapons have the range needed to engage enemy helicopters where they are most likely to operate. A battalion-sized task force composed of the Army's most capable weapons (M1 tanks; Bradley Fighting Vehicles; and the Chaparral, Vulcan, and Stinger air defense weapons) would have many weapons capable of engaging helicopters at ranges up to three kilometers. Indeed, a typical task force would have the potential for 14 engagements at three kilometers. Much beyond that range, however, today's force could not engage enemy helicopters attacking U.S. armored assets.

### PROGRAMS FOR IMPROVING FORWARD AIR DEFENSE

In the wake of the demise of DIVAD, the Army has hastened to beef up its battlefield air defenses. So far, the Army has developed a general plan for improving its air defenses. Many specifics are still to be determined, however. The Congressional Budget Office has examined this plan and four alternatives that the Congress could consider.

#### Army Plans

Recognizing the need to remedy the sparcity of air defenses against enemy standoff helicopters, the Army has earmarked funds and begun a five-part program to improve its air defense, and in particular its antihelicopter capability. (See the appendix for a detailed discussion of these plans.) In the President's budget for fiscal year 1987, the Army allocated \$1.5 billion (in fiscal year 1987 dollars) over the fiscal years 1987-1991 period for the two programs most closely related to forward area air defense. This represents about 1.5 percent of the funds included in the President's budget for total Army procurement for the same five-year period (see Summary Table 1).

One part of the Army's improvement plan for air defense would arm 720 of its scout helicopters with air-to-air missiles. The costs of this program over five years would be \$163 million. The second part, the so-called "Air Defense System, Heavy" (ADS, H) program, is also designed to improve air defense for the Army's maneuver elements. The purpose of the ADS, H program is to field, as soon as possible, a system to perform the mission for which the DIVAD was intended--that is, successfully destroy hovering enemy helicopters at their operating ranges. The Army has allocated almost \$1.4 billion over the 1987-1991 period for this program. The Army has not, however, decided what specific system to procure to

fulfill the ADS,H role, or how many of these systems it wishes to buy. It is, therefore, impossible to determine now whether the funds the Army has allocated for this program could provide enough capable systems to protect the forward maneuver elements.

### CBO Alternatives

CBO examined four approaches to improve the Army's ability to defend its forward area assets from air attack. All of the approaches include adding several types of weapons to the Army's current inventory (see Summary Tables 2 and 3). Only those systems that could be available for fielding in five years were included in the alternatives, since the Army appears to have an urgent need to improve its air defenses. The various alternatives were

SUMMARY TABLE 1. FUNDS PROJECTED BY THE ARMY FOR AIR DEFENSE AND TOTAL ARMY PROCUREMENT  
(By fiscal year, in millions of fiscal year 1987 dollars of budget authority)

Program	1987	1988	1989	1990	Total <sup>a/</sup> 1991	1987-1991
Helicopter Air-to-Air Capability	29	42	48	45	0	163
Air Defense System, Heavy	9	63	298	516	486	1,372
Subtotal, Air Defense	38	105	346	561	486	1,535
Total Army Procurement	18,600	20,400	20,300	20,600	21,500	101,400
Percent of Total Army Procure- ment Devoted to Air Defense	0.2	0.5	1.7	2.7	2.3	1.5

SOURCE: Compiled by the Congressional Budget Office from Army data.

a. Numbers may not add to totals because of rounding.

SUMMARY TABLE 2. PERFORMANCE AND COST OF FOUR AIR DEFENSE ALTERNATIVES

Type	Sophistication	Number per Division	Potential Engagements at Five Kilometers <u>a/</u>	Total Investment Cost (In billions of 1987 dollars)
Today's Force				
Vulcan	Low	24	0	Not Applicable
Stinger	Moderate	60		
Alternative I-- Enhance Current Systems				
PIVADS <u>b/</u>	Low	24		
Stinger	Moderate	60	3	0.4
Scout helicopters <u>c/</u>	Moderate	44		
Alternative II-- Deploy Many Simple Systems				
Simple Missile system	Moderate	72		
New alerting radar	Moderate	8	5	3.2
Scout helicopters <u>c/</u>	Moderate	44		
Alternative III-- Deploy a Few Sophisticated				
Radar missile systems	High	36		
Scout helicopters <u>c/</u>	Moderate	44	4	4.3
Alternative IV--Provide Tanks and Fighting Vehicles with Air Defense Capability				
Tanks <u>d/</u>	Low	290-350		
BFV and ITV <u>e/</u>	Low	376-430		
New alerting radar	Moderate	8	7-11	3.9
Stinger re- placement	Moderate	60		
Scout helicopters <u>c/</u>	Moderate	44		

SOURCE: Congressional Budget Office.

- a. By a battalion-sized task force.
- b. PIVADS = Product Improved Vulcan Air Defense System.
- c. With air-to-air missiles.
- d. With antihelicopter round.
- e. With replacement missile for TOW 2.  
BFV = Bradley Fighting Vehicle;  
ITV = Improved TOW Vehicle.



SUMMARY TABLE 3. COST OF ARMY'S PLAN AND CBO ALTERNATIVES  
(By fiscal year, in millions of 1987 dollars of budget authority)

	1987	1988	1989	1990	1991	Total 1987-1991	To Complete	Total Cost
Army's Plan <u>a/</u>	38	105	346	561	486	1,535	<u>b/</u>	<u>b/</u>
Alternative I	33	104	117	119	58	430	0	430
Change from Army plan (- or +)	-5	-1	-229	-442	-428	-1,105	<u>b/</u>	<u>b/</u>
Alternative II	65	241	417	779	680	2,171	985	3,156
Change from Army plan (- or +)	+61	+136	+71	+216	+194	+836	<u>b/</u>	<u>b/</u>
Alternative III	29	419	735	1,050	989	3,221	1,055	4,276
Change from Army plan (- or +)	-9	+314	+389	+489	+503	+1,686	<u>b/</u>	<u>b/</u>
Alternative IV	198	552	860	1,002	865	3,468	480	3,948
Change from Army plan	+160	+447	+514	+431	+379	+1,930	<u>b/</u>	<u>b/</u>

SOURCE: Congressional Budget Office.

NOTE: Numbers may not add to totals because of rounding.

- a. Includes the Army's program to add air-to-air missiles to 720 scout helicopters and the new Air Defense System, Heavy program--essentially a replacement for DIVAD.
- b. These numbers cannot be calculated since a specific Air Defense System, Heavy weapon has not yet been selected.

compared on the basis of the improvement in air defense they could afford over today's capability--as measured in terms of total potential engagements of hovering helicopters--and their associated investment cost. The costs attributed to the various alternatives are highly speculative inasmuch as they are associated with systems not currently under procurement. The costs of the various systems were, of necessity, based on contractor estimates and surrogate systems. Despite the uncertainty associated with the costs, however, they should reasonably represent the relative costs of the alternatives and are useful for comparative purposes.

#### Alternative I--Enhance Two Current Systems

This alternative would provide some defense against helicopters beyond three kilometers--at a total investment cost of \$430 million, \$1 billion less than the cost projected in the Army's plan--by adding air-to-air missiles to the scout helicopters now included in the divisions. The Army's current plan already includes adding missile launchers to its scout helicopters. The missile intended for the air-to-air role, however, is the infrared guided Stinger currently in the Army's inventory. This missile, or any missile relying on infrared guidance, would have marginal utility against hovering helicopters. Therefore, this alternative, in addition to providing scout helicopters with missile launchers, would equip the scouts with a new air-to-air missile that would be effective against hovering helicopters at ranges up to six km.

Providing the division's scout helicopters with air-to-air capability would be the most productive of any simple improvements that could be made to today's systems. All the alternatives in this report include this simple helicopter modification. Also in this alternative--but not in any of the others--Vulcan, the current anti-aircraft gun, would be upgraded and its range increased slightly, from 1,200 meters to 1,750 meters.

These improvements would add slightly to capability at short ranges and, more important, would provide a battalion task force with modest capability against enemy helicopters standing off at ranges greater than three kilometers. For example, a potential for three engagements of enemy helicopters at ranges from three and one-half to six kilometers would be obtained with this alternative. No capability exists at those ranges today (see Summary Figure).

All the key, long-range improvements provided by this alternative would, however, reside in the scout helicopters. These have other missions to perform that might detract from their ability to defend against enemy

helicopters when needed. Nor would this approach do anything to replace aging systems that are currently dedicated to air defense.

#### Alternative II--Deploy Large Numbers of Simple Air Defense Systems

This approach would emphasize the importance of numbers by providing a large number of new, dedicated air defense systems of moderate sophistication. The 24 Vulcans in each division would be replaced by three times as many simple missile systems with effective ranges of at least seven kilometers and eight new alerting radars would be provided for each division. As in Alternative I, scout helicopters would be armed with air-to-air missiles. The total investment cost of this alternative would be \$3.2 billion, of which \$2.2 billion would be spent during the next five fiscal years, and about \$1 billion in 1992 and later. Compared with the Army program, this alternative would require an additional \$836 million during the 1987-1991 period (see Summary Table 3).

Providing each division with 72 air defense systems capable of engaging helicopters at ranges of seven kilometers could--in combination with the division's scout helicopters--provide four to six helicopter engagements at ranges between three and six kilometers. This would exceed the potential engagements provided by Alternative I and, of course, compares favorably with today's total lack of engagement capability. Furthermore, this approach would provide one ground-based and one airborne air defense system, which should complicate the ability of enemy helicopters to survive while attacking maneuver forces.

On the other hand, this alternative would not provide much improvement in capability against fighter bombers or against aircraft operating in bad weather. Such capability would require air defense systems with more sophistication.

#### Alternative III--Deploy Smaller Numbers of Highly Sophisticated Systems

Emphasizing individual capability rather than numbers of systems is an alternate approach to providing air defense for the Army's forward units. This option would provide 36 sophisticated, radar-equipped missile systems to each of the Army's armored and mechanized divisions. As in all the options, air-to-air missiles would be added to the scout helicopters. The total required investment cost would be almost \$4.3 billion--\$3.2 billion during the next five years, and \$1.1 billion more after 1991. During the period from 1987 through 1991, almost \$1.7 billion more would be needed than the Army has included in its two most directly related programs (see Summary Table 3).

Under this alternative, helicopter engagements would increase to three to five engagements at between three and six kilometers, whereas today's force provides none. Moreover, the air defense units in this option would have their own acquisition radars, whereas simpler systems would have to rely on alerting and cueing from the division's early warning radars and on visual or infrared methods for locating individual targets. With their own radars, systems in this option could provide air defense in all types of weather and could engage high-speed, fixed-wing aircraft at longer ranges. These improvements are not captured in the measure of helicopter engagements used in this study, but this capability could be important on the European battlefield. Indeed, the Army has often stated its need for an air defense system directed by radar.

On the other hand, the cost per weapon system of adding a radar could constrain the number that could be deployed. Indeed, although this option would be more expensive than any of the others, it would provide one fewer engagement (a 20 percent to 30 percent reduction) at ranges between three and six kilometers than would Alternative II. Furthermore, the advantages of providing air defense systems with radars might be mitigated by operational constraints such as terrain, the lesser importance of the fixed-wing threat, and the reduced ability of enemy aircraft to operate effectively in bad weather.

#### Alternative IV--Provide Air Defense Capability to All Forward Combat Systems

Alternative III, with its sophisticated systems--and even Alternative II, with many more simpler systems--would not offer the large numbers of potential engagements that would provide reassurance of an effective defense in the chaotic conditions expected on the battlefield. To increase the numbers of potential engagements significantly, this approach would provide each of the roughly 700 armored vehicles within a division with some air defense capability. For example, the antitank missile of the Bradley Fighting Vehicle would be replaced with one capable of longer ranges and faster speeds. This would enable all of the 300 or more Bradleys within each division to engage helicopters out to a range of seven kilometers. In addition, tanks would be equipped with some antihelicopter rounds; the scout helicopters would be given air-to-air missiles; each division would receive eight alerting and cueing radars; and the Stinger shoulder-fired anti-aircraft missiles would be replaced with a missile having greater effective range against hovering helicopters.